

# **TOPIC 2 – ATOMIC STRUCTURE**

## **2.3 – ELECTRON ARRANGEMENT**

IB Chemistry  
T02D03



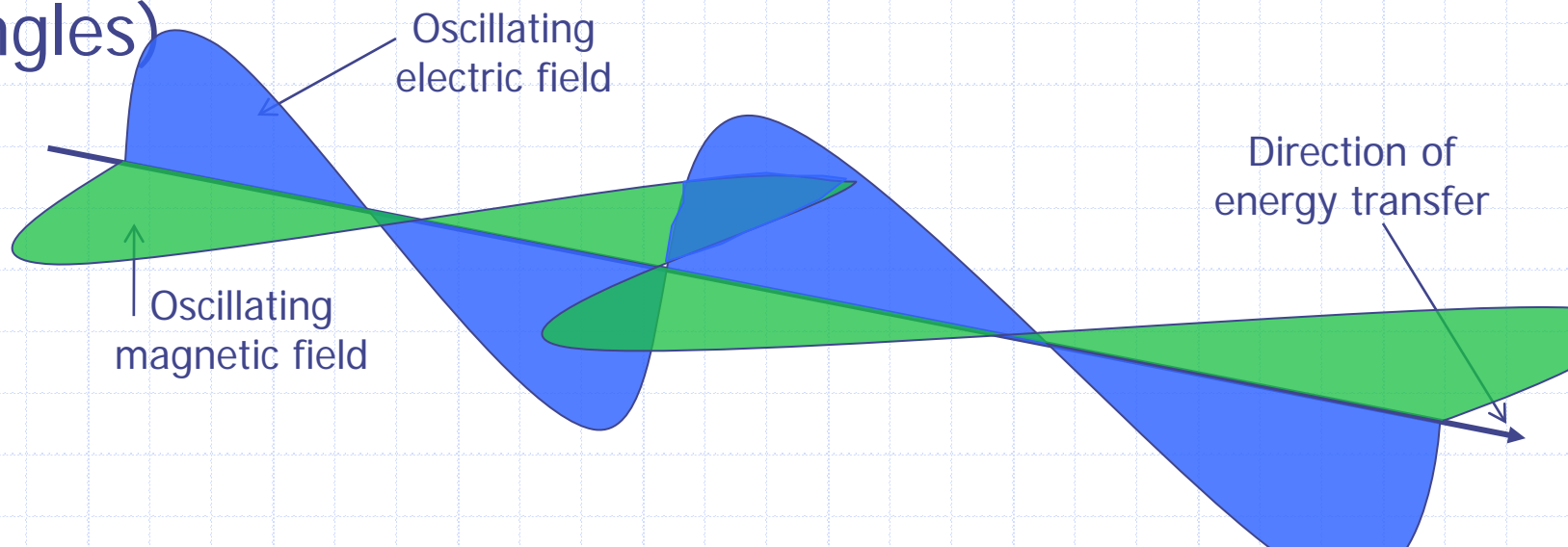
## 2.3 – Electron Arrangement - ? hrs

- 2.3.1 – Describe the electromagnetic spectrum
- 2.3.2 – Distinguish between a continuous spectrum and a line spectrum
- 2.3.3 – Explain how the lines in the emission spectrum of hydrogen are related to electron energy levels
- 2.3.4 – Deduce the electron arrangement for atoms and ions up to  $Z=20$



## 2.3.1 – Describe the electromagnetic spectrum

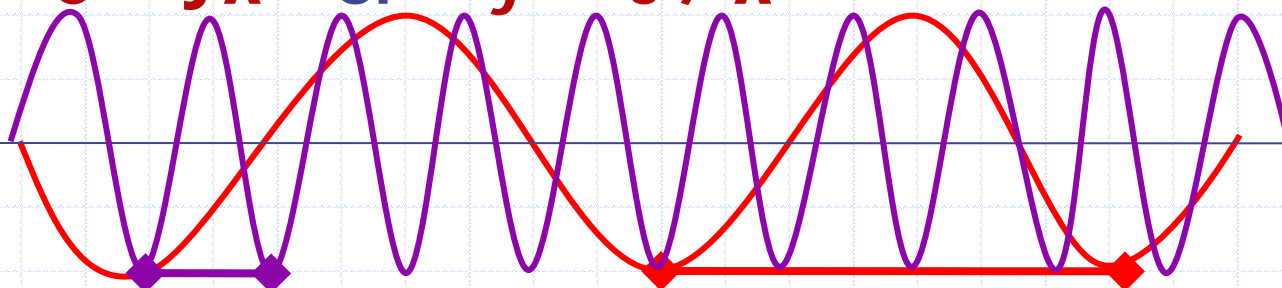
- Light is transformed in the form of **electromagnetic waves**
  - These waves consist of oscillating **electric** and **magnetic** waves traveling together in a sinusoidal (sin) wave
  - They are **perpendicular** to one another (right angles)



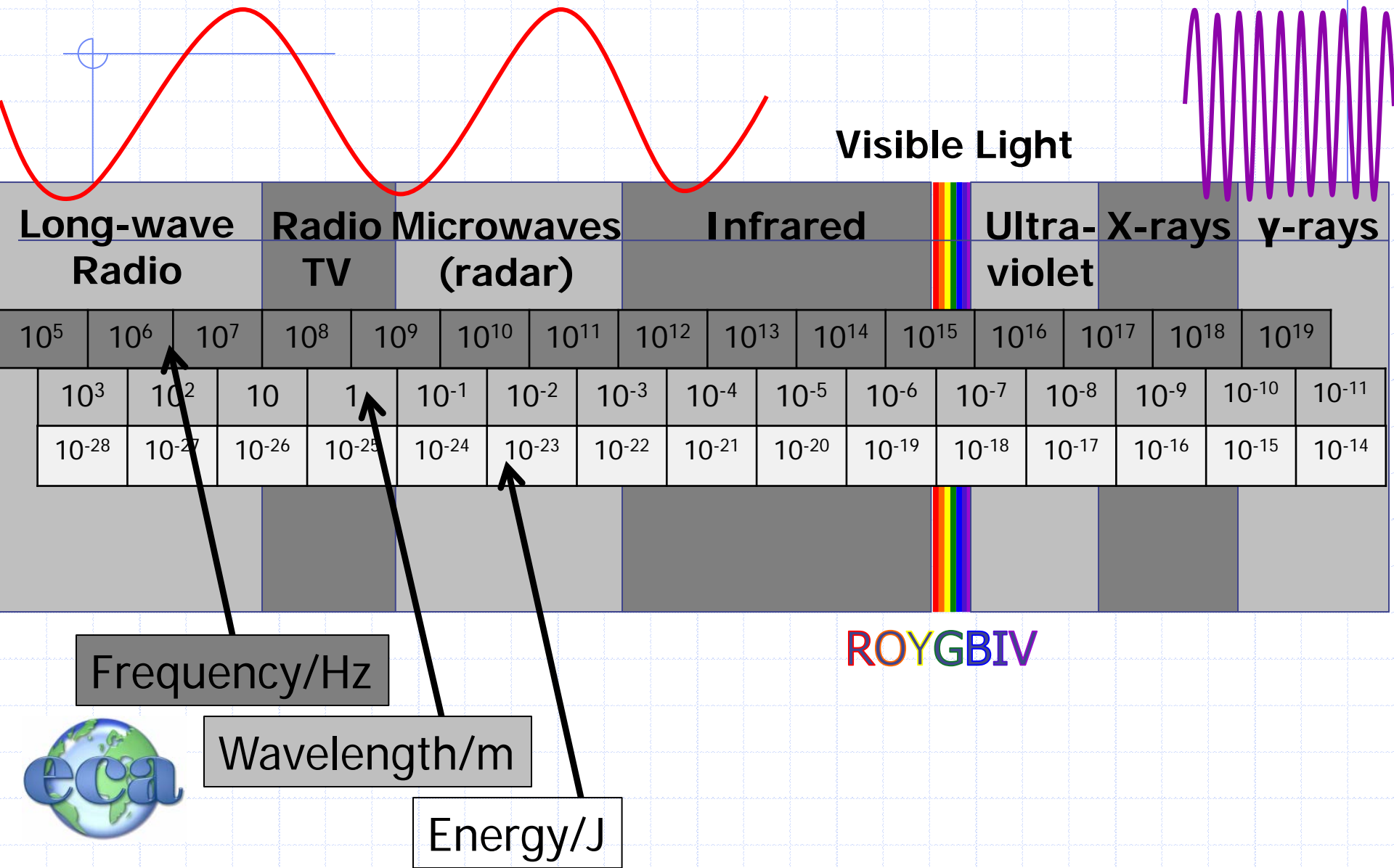
## 2.3.1 – Wave Properties

- **Wavelength** (lambda,  $\lambda$ ) is the distance between two neighboring crests or troughs of a wave
- **Frequency** ( $f$ ) is the number of waves that pass a given point in one second, recorded in **hertz** (Hz)
- **Speed** ( $c$ ) is the distance travelled by a wave in one second, recorded in meters/second ( $\text{ms}^{-1}$ )
- **Wave Equation** expresses the relationship between each of the three, where  $c$  (speed) is the speed of light,  $c = 3 \times 10^8 \text{ ms}^{-1}$ .

■  $C = f\lambda$  or  $f = c / \lambda$

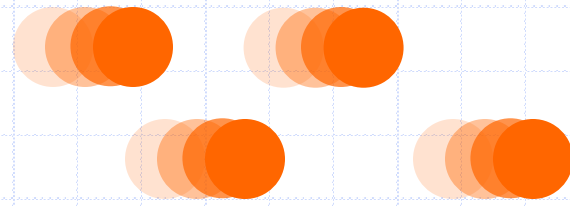
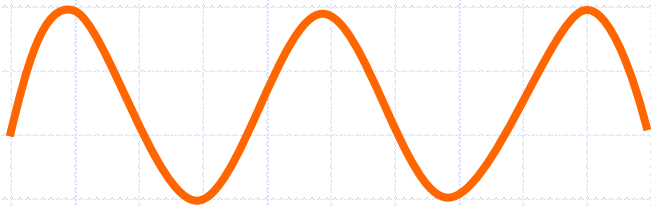


# 2.3.1 – Electromagnetic Spectrum



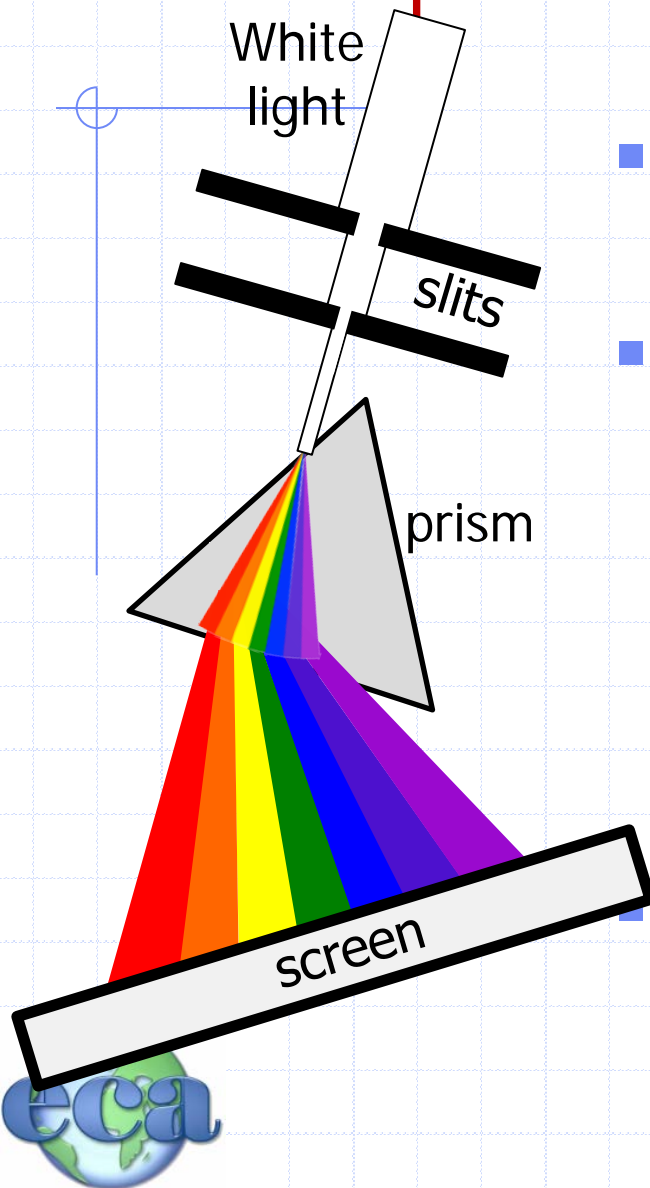
## 2.3.1 – Planck's constant

- Light can also be described as particles (photons) which are tiny packets of energy
- The wave and particle models can be related through **Planck's constant**.
  - **$E = hf$**
  - E is the energy of a photon (in joules)
  - h is Planck's constant ( $6.63 \times 10^{-34}$  Js)
  - $f$  is the frequency as before



2.3

## 2.3.2 – Distinguish between a continuous spectrum and a line spectrum



- **White light** is an intense blend of all colors of light
- A **continuous spectrum** of light is composed of all the visible colors of white light. Like a rainbow where there is a smooth blend of an infinite number of colors
- A **line spectra** is one which contains only a narrow emission of colors on a black background

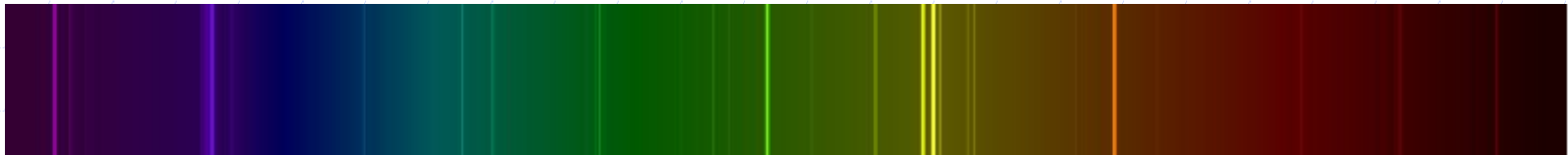
## 2.3.2 – Line Spectra

- We will complete a lab that helps us to better understand line spectra.
- For now 2.3.3 will allow to conceptualize the general idea

Hydrogen



Mercury



Argon



Helium





## 2.3 2.3.3 – Explain how the lines in the emission spectrum of hydrogen are related to electron energy levels

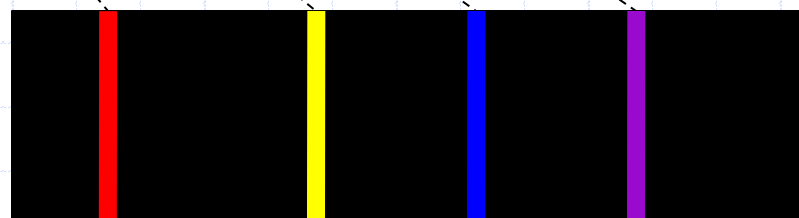
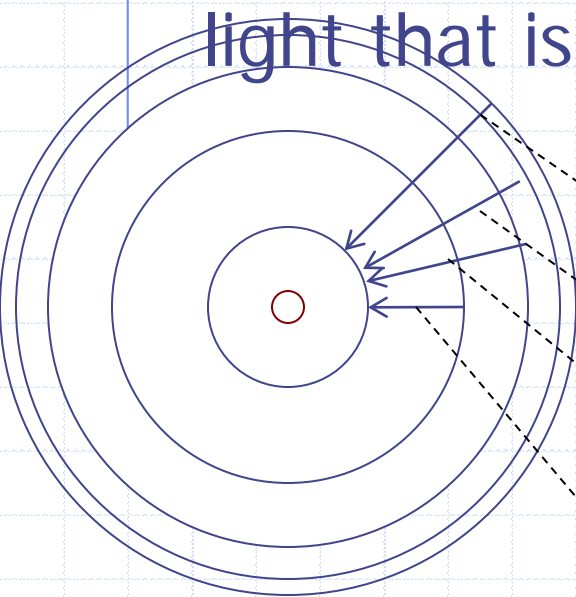
- As discussed, **Bohr's Theory** was based on the evidence for energy levels present within the atom
  - Electrons traveling within a specific orbit does not emit energy
  - In order for an electron to move to an orbit further from the nucleus, it must absorb energy
  - When these excited electrons drop back to their ground state they emit a spectrum of energy
  - The energy of the light emitted is equal to the energy difference between the two orbits



## 2.3.3 – Electron Emission Energy

- The difference in energy levels as electrons move corresponds to the energy of the wavelength of light that is emitted during the process

- The difference in energy level is also known as “**quanta**” which is where the term quantum theory derives itself



2→1

3→1

4→1

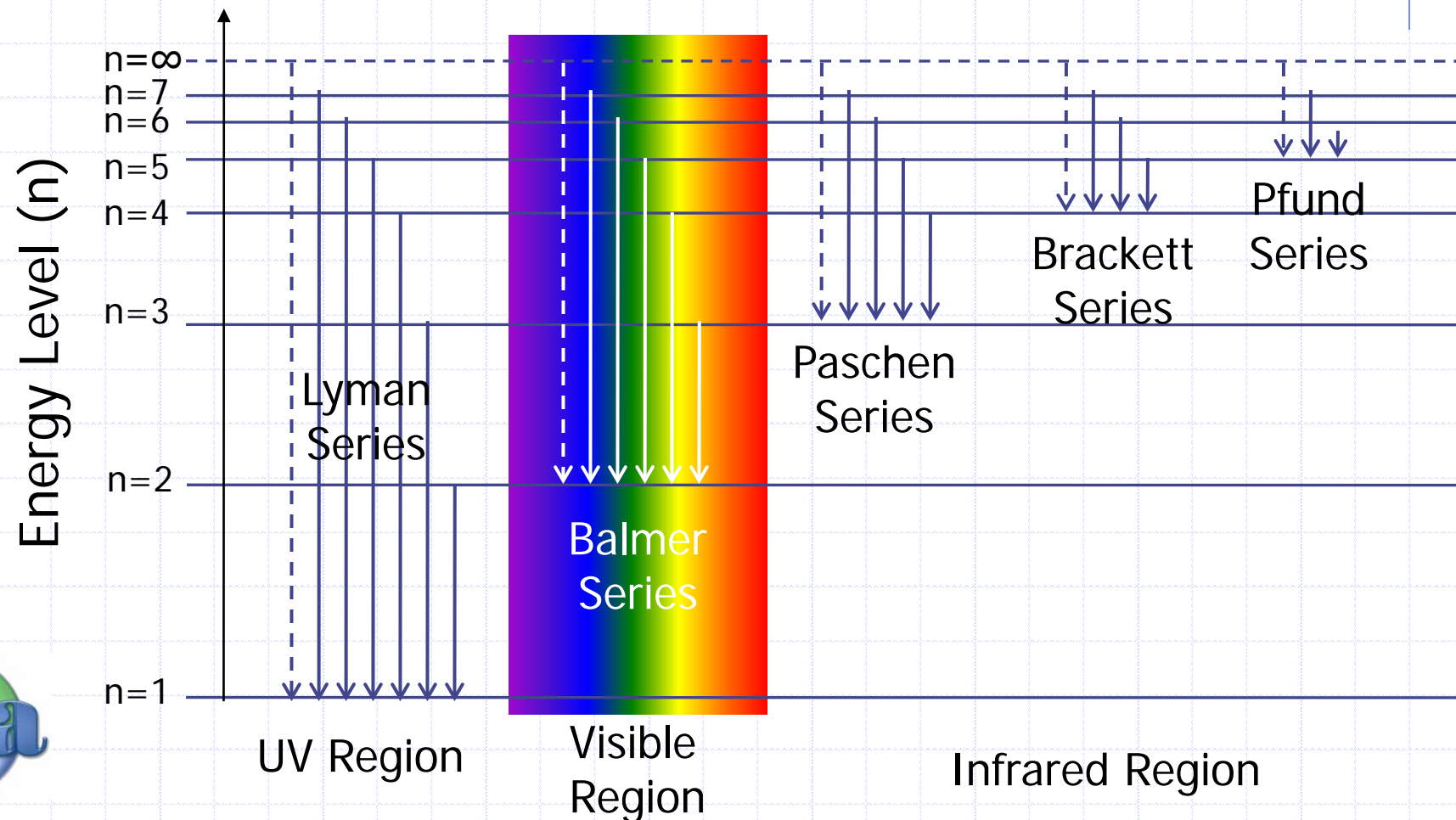
5→1

*\*This diagram is an over-simplification of what occurs from level to level. The concept and trend holds true, the specifics about colors do not necessarily*



## 2.3.3 – Hydrogen Emission

The origin of each of hydrogen's emissions can be summarized through the following diagram



## 2.3.4 – Deduce the electron arrangement for atoms and ions up to $Z=20$

- *NOTE: SL and HL will learn a different (and more correct) method of assigning electron configurations rather than just electron arrangement.*
- The electron arrangement for the first 20 elements follows the 2,8,8 trend
- Any IB questions that requires the electron arrangement to be assigned will also accept the more precise electron configuration

